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EXAMINER	
SONG, MATTHEW J	
ART UNIT	**PAPER NUMBER**
1765	

DATE MAILED: 08/23/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)
	10/028,610	OMSTEAD ET AL.
	Examiner	Art Unit
	Matthew J Song	1765

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 26 September 2003.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-32 is/are pending in the application.

4a) Of the above claim(s) 12,22 and 32 is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-11,13-21 and 23-31 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date 12/19/01; 7/1/02.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

1. Claims 12, 22 and 32 withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected invention, there being no allowable generic or linking claim. Election was made **without** traverse in the reply filed on 9/26/2003.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

3. Claim 15 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter, which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. Claim 15 recites, "the first process gas and the second process gas are not diverted from the plurality of wafer stations as the atomic layer deposition film is formed" in lines 1-3. Claim 15 depends from claim 13, which recites, " rotating the first precursor gas and the second process gas sequentially to at least the first wafer station and the second wafer station" in lines 10-12. There is no enabling disclosure to permit the two limitations to be performed. The first limitations requires the gases to be stationary and the second requires rotation of the gases, which is the exact opposite for the depending claim limitation.

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter, which the applicant regards as his invention.

5. Claim 15 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claim 15 recites, "the first process gas and the second process gas are not diverted from the plurality of wafer stations as the atomic layer deposition film is formed" in lines 1-3. It is unclear what "not diverted" is intended to mean because claim 13, which claim 15 depends, recites rotating the process gases to form an atomic layer deposition film. In other words, how can a person of ordinary skill not divert gases while rotating them between wafer stations?

6. Claims 25 rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claim 25 recites, " a delta shape". It is unclear what a "delta" shape is intended to represent.

Claim Rejections - 35 USC § 102

7. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

8. Claims 1, 2, 3, 5, 6, 8, 9, 13-15, 17, 19-20 and 23 are rejected under 35 U.S.C. 102(b) as being anticipated by Gadgil et al (US 5,879,459).

Gadgil et al discloses providing a multi-wafer sequential deposition module having a plurality of wafer stations (col 6, ln 30-50; col 15, ln 1-40 and Figure 7). Gadgil et al also discloses inserting a plurality of wafers within the multi-wafer sequential deposition module (col 12, ln 55-67). Gadgil et al also discloses substrate can be unloaded from one compact reactor unit and reloaded to another compact reactor unit in any sequence (col 13, ln 1-5), this reads on applicants' rotating the plurality of wafers in a sequential fashion among the plurality of wafer stations. Gadgil et al discloses performing atomic layer deposition on the wafer in the plurality of wafer stations by puling precursor and gas purging in a sequential manner, as required by an ALD sequence (col 15, ln 50 to col 16, ln 25), this reads on applicants' depositing a monolayer because atomic layer deposition by definition requires the deposition of a monolayer. Gadgil et al also discloses there may be two or more valved charge tubes adapted for injecting separate gases into the individual reactors and operation of a remotely-operable charge valves and injection valves is programmable to integrate injection of gases into the individual compact reactors in concert with transfer of substrates into and out of compact reactors (col 6, ln 10-30), this reads on applicants' rotating a plurality of process gases in sequential fashion among the plurality of wafer stations to complete the atomic layer deposition on each of the plurality of wafers.

Referring to claim 2, Gadgil et al discloses after all of the processes have been performed in the reactor units, the are unloaded, this reads on applicants' removing the wafer when a desired deposition layer thickness is obtained. Gadgil et al also discloses transfer continues until

all substrates from a load lock are transferred to the reactor unit, this reads on supplying at least one additional wafer (col 13, ln 50 to col 14, ln 15).

Referring to claim 3, Gadgil et al discloses individual compact reactors comprise a charge tube adapted for injecting separate gases and injection valves are programmable to integrate injection of separate gases into individual reactors in concert with transfer of substrates, this reads on applicant directing plurality of process gases directly from one station to the next because the injection valves direct the process gas to the substrates.

Referring to claim 5, Gadgil et al discloses a first (A) and second (B) precursor gas (Fig 1a, 1b, Fig 9 and col 3, ln 1-67) and a injection valve connected to a charge tube to supply individual reactors reactant gases (col 6, ln 10-30), this reads on applicants' rotating gases.

Referring to claim 6, Gadgil et al discloses alternating purge gases and process gases (col 9, ln 1-10), this reads on applicants' supplying inert gas to a wafer station not receiving a process gas.

Referring to claim 8, Gadgil et al discloses a CVD process unit with a VESCAR (ALD) processing unit (col 6, ln 30-65 and col 17, ln 15-60).

Referring to claim 9, Gadgil et al discloses using reactant gases (col 3, ln 5-60 and col 9, ln 1-15).

Referring to claim 13, Gadgil et al discloses substrates can be unloaded from one compact reactor unit and reloaded to another compact reactor unit and any sequence is possible (col 13, ln 1-5). Gadgil et al also discloses serial processing (col 15, ln 35-50), this reads on applicants' moving a plurality of wafers in a sequential order among the plurality of wafer stations.

Referring to claim 14, Gadgil et al discloses deposition of a portion of the total thickness (Fig 1a).

Referring to claim 15, Gadgil et al discloses supplying gases to the wafer station for atomic layer growth, the gases are supplied until a desired atomic layer is formed, this reads on applicants' the first and second process gas are not diverted from the plurality of wafer stations as the atomic layer is formed because the gases are not changed until after a desired atomic layer is formed.

Referring to claim 23, Gadgil et al discloses a plurality of gas manifolds **55**, specifically three (col 15, ln 50-67), this reads on applicants' plurality of showerheads.

Referring to claim 24, Gadgil et al discloses ALD.

9. Claims 23, 24 and 26 are rejected under 35 U.S.C. 102(b) as being anticipated by McInerney et al (US 6,143,082).

McInerney et al discloses a method for applying a deposition layer on a semiconductor substrate comprising providing a multi-wafer sequential deposition module **100** having a plurality of wafer stations **112, 114, 116, 118** and a plurality of showerheads **132, 134, 136, 138** (col 3, ln 5-67 and col 1, ln 10-67). McInerney et al also discloses inserting a plurality of wafers within the multi-wafer deposition module (col 9, ln 10-50) and flowing silane, hydrogen, argon, tungsten hexafluoride through the showerheads (col 9, ln 35 to col 10, ln 25). McInerney et al also discloses a wafer indexing plate rotates to position the wafers in the next processing stations to complete tungsten deposition (col 10, ln 1-65).

Referring to claim 24, McInerney et al discloses a tungsten CVD process (col 1, ln 10-55).

Referring to claim 26, McInerney et al discloses reactive gases (col 5, ln 30-35), this reads on applicants' reactant gases.

Claim Rejections - 35 USC § 103

10. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

11. Claims 4 and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gadgil et al (US 5,879,459) in view of Haines et al (US 5,251,148).

Gadgil et al teaches all of the limitations of claim 4, as discussed previously, except Gadgil et al does not teach the rotating of the plurality of process gases is performed by a rotary

ball valve. Gadgil et al does teach rotating gases using a charge valves and injection valves to inject gases into reactors in concert with the transfer of substrates (col 6, ln 10-30).

In a method of process control, Haines et al teaches control valves used in a control the flow of gases and to regulate pressure. Haines et al also teaches typical control valves are rotary ball valves, globe valves and gate valves (col 1, ln 5-45). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Gadgil et al with Haines et al's typical rotary ball valve because rotary ball valves are conventionally used means in the control of gas flow.

12. Claims 7 and 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gadgil et al (US 5,879,459) in view of Izu et al (US 4,545,136).

Gadgil et al teaches all of the limitations of claim 7, as discussed previously, except Gadgil et al does not teach flowing an inert gas between each of the plurality of wafer stations to isolate each of the plurality of process gases and prevent undesired deposition.

In a method of isolating the interior of a chamber, note entire reference, Izu et al teaches a means for maintaining inert gas to create a curtain of non-reactive gas to isolate the interior of a chamber from other reactants at the inlet and outlet valves (col 2, ln 5-25 and Abstract), this reads on applicants inert gas between each of the plurality of wafer stations to isolate each of the process gases and prevent undesired deposition. Izu et al also teaches the inert gas curtain isolates reaction gases in adjacent deposition chamber and prevents the reaction gas mixture in one deposition chamber from contaminating the reaction gas mixture of the adjacent chamber in a vapor deposition chamber adapted to sequential travel through a plurality of interconnected

chambers (claim 1). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Gadgil et al by using Izu et al inert gas curtain to prevent contamination in adjacent reaction chambers.

13. Claims 10 and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gadgil et al (US 5,879,459) as applied to claims 1, 2, 3, 5, 6, 8, 9, 13-15, 17, 19-20 and 23 above, and further in view of Rossnagel et al ("Plasma enhanced atomic layer deposition of Ta and Ti for interconnect diffusion barriers") and Nakayama et al (US 5,125,360).

Gadgil et al teaches all of the limitations of claim 10, as discussed previously, except at least one of the plurality of wafers is biased by delivering electrical power to the substrate holder of the corresponding wafer station.

In a method of atomic layer deposition, Rossnagel et al teaches much like CVD, ALD can be stimulated or enhanced by the use of plasma, which can result in increased reaction rate on surfaces, increased fragmentation of precursor molecules, bombardment enhancement of the removal product molecules and lower substrate temperatures (pg 2016). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Gadgil et al by using a plasma enhanced ALD to reduce operating temperatures and increase reaction rate.

The combination of Gadgil et al and Rossnagel et al teaches a plasma enhanced ALD process, however the combination of Gadgil et al and Rossnagel et al does not teach at least one wafer is biased.

In a method of chemical vapor deposition, Nakayama et al teaches in plasma CVD, generally RF bias is applied to the substrates to be processed and a suitable DC bias voltage is

applied to the substrates in order to improve the property of the thin film to be formed on the substrate and step coverage (col 6, ln 60-68). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the plasma process taught by the combination of Gadgil et al and Rossnagel et al with Nakayama's substrate bias to improve the property of the thin film and the step coverage.

14. Claims 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gadgil et al (US 5,879,459) as applied to claims 1, 2, 3, 5, 6, 8, 9, 13-15, 17, 19-20 and 23 above, and further in view of Rossnagel et al ("Plasma enhanced atomic layer deposition of Ta and Ti for interconnect diffusion barriers") and Foster et al (US 5,866,213).

Gadgil et al teaches all of the limitations of claim 11, as discussed previously, except a spacing between a showerhead at least one of the plurality of wafer stations and at least on of the plurality of wafers is set for plasma processing.

In a method of atomic layer deposition, Rossnagel et al teaches much like CVD, ALD can be stimulated or enhanced by the use of plasma, which can result in increased reaction rate on surfaces, increased fragmentation of precursor molecules, bombardment enhancement of the removal product molecules and lower substrate temperatures (pg 2016). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Gadgil et al by using a plasma enhanced ALD to reduce operating temperatures and increase reaction rate.

The combination of Gadgil et al and Rossnagel et al teaches a plasma enhanced ALD process, however the combination of Gadgil et al and Rossnagel et al does not teach a spacing

between a showerhead at least one of the plurality of wafer stations and at least on of the plurality of wafers is set for plasma processing.

In a method of plasma CVD, Foster et al teaches a RF electrode plasma generation method comprising an RF showerhead/electrode, which generates plasma very close to the surface of the substrate and the proximity for the plasma to the substrate ensures an ample density of activated radicals and ions, this reads on applicants' spacing for plasma generation. Foster et al also teaches deposition of titanium films (col 6, ln 1-40). Foster et al also teaches a remote plasma generation method and an RF method for plasma generation (col 4, ln 30-55), this is a teaching that the remote plasma and RF method are equivalent methods for plasma generation in CVD. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Gadgil et al and Rossnagel et al remote plasma generation method with Foster et al's method of plasma generation using RF electrode method because substitution of known equivalents for the same purpose is held to be obvious (MPEP 2144.06).

15. Claims 10-11 and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gadgil et al (US 5,879,459) as applied to claims 1, 2, 3, 5, 6, 8, 9, 13-15, 17, 19-20 and 23 above, and further in view of Ameen et al (US 6,143,128).

Gadgil et al teaches all of the limitations of claim 10, as discussed previously, except at least one of the plurality of wafers is biased by delivering electrical power to the substrate holder of the corresponding wafer station. Gadgil et al also teaches a cluster tool, where ALD units may

be integrated in some system embodiments with other process units such as CVD, etching or a cleaning module (col 6, ln 30-55 and col 17, ln 40-50).

In a method of cleaning semiconductor wafers, Ameen et al teaches cleaning using a soft etch equipped module. Ameen et al also teaches delivering hydrogen and energized plasma. Ameen et al also teaches the soft etch module is a module of cluster tool connected to a transfer module which the substrate can be transferred into a CVD or other coating module. Ameen et al also teaches the wafer may be biased to utilize some physical sputtering in the cleaning (col 4, ln 1-65). Ameen et al also teaches the chamber is provided with a plasma electrode, preferably formed by fabricating the showerhead out of a conductive material and the electrode and susceptor form a parallel plate plasma generator (col 7, ln 30-50), this reads on applicants' a spacing between a showerhead of at least one of the plurality of wafer stations and at least one of the plurality of wafers is set for plasma processing. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Gadgil et al's cluster tool with Ameen et al's cleaning module adapted for a cluster tool to clean a semiconductor wafer prior to deposition, which is desirable.

16. Claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over Gadgil et al (US 5,879,459) as applied to claims 1, 2, 3, 5, 6, 8, 9, 13-15, 17, 19-20 and 23 above, and further in view of Izu et al (US 4,545,136).

Gadgil et al teaches all of the limitations of claim 18, as discussed previously, except Gadgil et al does not teach flowing an inert gas between each of the plurality of wafer stations.

In a method of isolating the interior of a chamber, note entire reference, Izu et al teaches a means for maintaining inert gas to create a curtain of non-reactive gas to isolate the interior of a chamber from other reactants at the inlet and outlet valves (col 2, ln 5-25 and Abstract), this reads on applicants inert gas between each of the plurality of wafer stations to isolate each of the process gases and prevent undesired deposition. Izu et al also teaches the inert gas curtain isolates reaction gases in adjacent deposition chamber and prevents the reaction gas mixture in one deposition chamber from contaminating the reaction gas mixture of the adjacent chamber in a vapor deposition chamber adapted to sequential travel through a plurality of interconnected chambers (claim 1). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Gadgil et al by using Izu et al inert gas curtain to prevent contamination in adjacent reaction chambers.

17. Claims 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over McInerney et al (US 6,143,082) or Gadgil et al (US 5,879,459).

McInerney et al or Gadgil et al teaches all of the limitations of claim 25, as discussed previously, except McInerney et al or Gadgil et al is silent to the shape of the showerhead is a triangular, delta or linear shaped.

Changes is shape are held to be obvious (MPEP 2144.04). Therefore, It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify McInerney et al or Gadgil et al by changing the shape of the showerhead to obtain same because changes in shape are held to be obvious (MPEP 2144.04).

18. Claims 25 are rejected under 35 U.S.C. 103(a) as being unpatentable over McInerney et al (US 6,143,082) or Gadgil et al (US 5,879,459) as applied to claims 23-24 above, and further in view of Ballance et al (US 5,781,693).

McInerney et al or Gadgil et al teaches all of the limitations of claim 25, as discussed previously, except McInerney et al or Gadgil et al is silent to the shape of the showerhead is a triangular, delta or linear shaped.

In a gas introduction showerhead, Ballance et al teaches a linear showerhead (Figure 1 and Fig 8). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify McInerney et al or Gadgil et al by using a linear shape, as taught by Ballance et al, because changes in shape are held to be obvious (MPEP 2144.04).

19. Claims 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over McInerney et al (US 6,143,082) in view of Izu et al (US 4,545,136).

McInerney et al teaches all of the limitations of claim 27, as discussed previously, except McInerney et al does not teach providing an inert gas curtain between each of the plurality of showerheads.

In a method of isolating the interior of a chamber, note entire reference, Izu et al teaches a means for maintaining inert gas to create a curtain of non-reactive gas to isolate the interior of a chamber from other reactants at the inlet and outlet valves (col 2, ln 5-25 and Abstract), this reads on applicants inert gas between each of the plurality of wafer stations to isolate each of the process gases and prevent undesired deposition. Izu et al also teaches the inert gas curtain isolates reaction gases in adjacent deposition chamber and prevents the reaction gas mixture in

one deposition chamber from contaminating the reaction gas mixture of the adjacent chamber in a vapor deposition chamber adapted to sequential travel through a plurality of interconnected chambers (claim 1). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify McInerney et al by using Izu et al inert gas curtain to prevent contamination in adjacent reaction chambers.

20. Claims 29 and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over McInerney et al (US 6,143,082) as applied to claims 23, 24 and 26 above, and further in view of Nakayama et al (US 5,125,360).

McInerney et al teaches all of the limitations of claim 29, as discussed previously, except at least one of the plurality of wafers is biased by delivering electrical power to the substrate holder of the corresponding wafer station.

In a method of chemical vapor deposition, Nakayama et al teaches in plasma CVD, generally RF bias is applied to the substrates to be processed and a suitable DC bias voltage is applied to the substrates in order to improve the property of the thin film to be formed on the substrate and step coverage (col 6, ln 60-68). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the process taught by McInerney et al with Nakayama's plasma CVD using a substrate bias to improve the property of the thin film and the step coverage and also to reduce operating temperatures, as taught by Rossnagel et al above.

21. Claims 28 and 31 are rejected under 35 U.S.C. 103(a) as being unpatentable over McInerney et al (US 6,143,082) as applied to claims 23, 24 and 26 above, and further in view of Foster et al (US 5,866,213).

McInerney et al teaches all of the limitations of claim 28, as discussed previously, except at least one of the plurality of showerheads is electrically powered to provide a plasma environment.

In a method of plasma CVD, Foster et al teaches a RF electrode plasma generation method comprising an RF showerhead/electrode, which generates plasma very close to the surface of the substrate and the proximity for the plasma to the substrate ensures an ample density of activated radicals and ions, this reads on applicants' spacing for plasma generation. Foster et al also teaches deposition of titanium films (col 6, ln 1-40). Foster et al also teaches a remote plasma generation method and an RF method for plasma generation (col 4, ln 30-55), this is a teaching that the remote plasma and RF method are equivalent methods for plasma generation in CVD. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify McInerney et al with Foster et al's method of plasma CVD using RF electrode method because plasma enhanced processes increase reaction rates at lower processing temperatures, which is desirable, as taught by Rossnagel et al.

22. Claims 28-31 are rejected under 35 U.S.C. 103(a) as being unpatentable over McInerney et al (US 6,143,082) as applied to claims 23, 24 and 26 above, and further in view of Ameen et al (US 6,143,128).

McInerney et al teaches all of the limitations of claim 28, as discussed previously, except at least one of the plurality of showerheads is electrically powered to provide a plasma environment.

In a method of cleaning semiconductor wafers, Ameen et al teaches cleaning using a soft etch equipped module. Ameen et al also teaches delivering hydrogen and energized plasma. Ameen et al also teaches the soft etch module is a module of cluster tool connected to a transfer module which the substrate can be transferred into a CVD or other coating module. Ameen et al also teaches the wafer may be biased to utilize some physical sputtering in the cleaning (col 4, ln 1-65). Ameen et al also teaches the chamber is provided with a plasma electrode, preferably formed by fabricating the showerhead out of a conductive material and the electrode and susceptor form a parallel plate plasma generator (col 7, ln 30-50), this reads on applicants' a spacing between a showerhead of at least one of the plurality of wafer stations and at least one of the plurality of wafers is set for plasma processing. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify McInerney et al with Ameen et al's cleaning module adapted for a cluster tool to clean a semiconductor wafer prior to deposition, which is desirable.

Referring to claim 30, the combination of McInerney et al and Ameen et al is silent to the film properties of the deposition layer is modified. The film properties of the deposition layer will inherently be improved by removing impurities prior to deposition, this reads on applicants' modified film properties.

Conclusion

23. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Gordon (US 5,656,338) teaches a gas distribution manifold ("showerhead") used in a chemical vapor deposition apparatus (col 5, ln 15-25).

Goodwin et al (US 5,997,588) teaches a gas curtain for use with a semiconductor processing system to prevent unwanted gases from entering a processing chamber. Goodwin et al also teaches the gas curtain removed particles, moisture and unwanted gases (Abstract).

Sherman (US 5,916,365) teaches a plasma enhanced sequential deposition of monolayers (abstract).

Sandhu et al (US 2002/0195056) teaches a versatile atomic layer deposition apparatus comprising rotation of substrate to separate deposition chambers comprising different deposition condition and the deposition chambers are also separated by an inert gas curtain (note entire reference).

24. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew J Song whose telephone number is 571-272-1468. The examiner can normally be reached on M-F 9:00-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on 571-272-1465. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Matthew J Song
Examiner
Art Unit 1765

MJS

NADINE G. NORTON
SUPERVISORY PATENT EXAMINER